The Sample at Mars Analysis (SAM) detections of CO_2 and CO in sedimentary material from Gale Crater, Mars: Implications for the presence of organic carbon and microbial habitability on Mars.

Sutter, Eigenbrode, Steele, Ming, others??

Sedimentary rock samples heated to 860°C in the SAM instrument evolved CO_2 and CO indicating the presence of organic-carbon(C) in Gale Crater materials. Martian or exogenous (meteoritic, interplanetary dust) CO_2 and CO could be derived from combustion of simple organics (<300°C), complex refractory organics/amorphous carbon (300-600°C), and/or magmatic carbon (>600°C) as result of thermal decomposition of Gale Crater perchlorates, and sulfates present that produce O_2. Oxidized organic compounds could also evolve CO_2 and CO over broad temperature range (150 to 800°C) and such organics are expected on Mars via exogenous sources. Alternatively, organic-C could also have been oxidized to carboxylic acids [e.g, mellitic acid (RCOOH), acetate ($CH_3CO_2^-$), and oxalates ($C_2O_4^{2-}$)] by oxidative radiolytic weathering, or other oxidation processes. The presence of oxidized organics is consistent with the limited detection of reduced organic-C phases by the SAM-gas chromatography. Organic-C content as determined by CO_2 and CO contents could range between 800 and 2400 ppm C indicating that substantial organic-C component is present in Gale Crater. There are contributions from SAM background however, even in worse case scenarios, this would only account for as much as half of the detected CO_2 and CO. Nevertheless, if organic-C levels were assumed to have existed in a reduced form on ancient Mars and this was bioavailable C, then <1% of C in Gale Crater sediments could have supported an exclusively heterotrophic microbial population of 1×10^5 cells/g sediment (assumes 9×10^{-7} µg/cell and 0.5 µg C/µg cell). While other essential nutrients (e.g., S and P) could be limiting, organic-C contents, may have been sufficient to support limited heterotrophic microbial populations on ancient Mars.